Title: The Chances Are . . .

Brief Overview:

This unit is designed as an introduction and exploration of the concept of probability. Students will manipulate a variety of everyday materials to discover the various possibilities of chance results. They will collect, organize, and interpret data both individually and as a class. This will illustrate the concept that with more and more data, experimental probability leads to mathematical probability.

Link to Standards:

- **Problem Solving** Students will use problem-solving approaches to investigate and understand mathematical content. They will verify and interpret results with respect to the original problem. They will acquire confidence in using mathematics meaningfully.

- **Communication** Students will relate physical materials, pictures, and diagrams to mathematical ideas. They will reflect on and clarify their thinking about mathematical ideas and solutions. They will relate their everyday language to mathematical language and symbols. They will realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics.

- **Reasoning** Students will draw logical conclusions about mathematics. They will use models, known facts, properties, and relationships to explain their thinking. They will justify their answers and solution processes. They sill believe mathematics makes sense.

- **Connections** Students will link conceptual and procedural knowledge. They will relate various representations of concepts of procedures to one another. They will use mathematics in other curriculum areas. They will use mathematics in their daily lives.

- **Estimation** Students will determine the reasonableness of results.

- **Number Sense & Numeration** Students will construct number meaning through real-world experiences and the use of physical materials. They will develop number sense.

- **Whole Number Operations** Students will develop meaning for the operations by modeling and discussing a rich variety of problem situations.

- **Whole Number Computation** — Students will model, explain, and develop reasonable proficiency with basic facts and algorithms. They will use a variety of mental computation and estimation techniques.
- **Statistics** — Students will collect, organize, and describe data. They will construct, read, and interpret displays of data. They will formulate and solve problems that involve collecting and analyzing data. They will explore concepts of chance.
- **Fractions & Decimals** — Students will develop number sense for fractions and decimals. They will apply fractions and decimals to problem situations.
- **Patterns & Relationships** — Students will represent and describe mathematical relationships.

Grade/Level:

Grades 3-5

Duration/Length:

This learning unit will take approximately 2 to 3 days to complete, with 30 to 45 minute math periods.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Charts, tables, and graphs
- Basic concepts of fractions (Grades 3-4)

Objectives:

Students will:

- work cooperatively in groups.
- collect and organize data.
- correctly use tally marks.
- express results in grade appropriate form.
- verbally define and give an example of probability in real life.

Materials/Resources/Printed Materials:

- Calculator
- Five-colored spinners
- Small plastic cups
- Chart paper
- Graph paper
- Paper for student charts
- One inch squares of cardboard

Development/Procedures:

Day 1:

A. Set up an unfair/fair situation.

Option 1: Randomly divide the class into two unequal teams to play a favorite class game. (Example: Five students versus fifteen students flash card game.) Let the children play the game to experience the fair/unfair concept.

Option 2: Divide the class into pairs to play a number cube chance game. One student chooses one number from a cube. The second student takes the remaining numbers from the cube. Partners begin to roll the cube to determine a winner. After ten rolls the winner is the student who has successfully rolled their number(s) the most. They will begin to see the fair/unfair concept.

B. Use these options to lead into a discussion about the fair/unfair situations created in the games. This should lead to further discussion involving/introducing the terms "chance" and "probability."

C. As a result of this discussion, students will develop a working definition of "probability." A possible definition might be "Probability is the chance that something will occur."

D. Culminate this introductory discussion with brainstorming and listing real-life situations where probability is seen and used daily.

Day 2:

A. Review previous day's activity and the definition of probability.

B. While holding a plastic cup, the teacher says, "Today we are going to further explore probability." The teacher will ask the following question: "If I drop this cup from my waist how many different ways are there for it to land?" (Appropriate answers should be: up, down, and on the side.)

C. The teachers says, "Using the definition of probability that the class generated, what can we predict will happen when we drop the cup three times?" (Accept and record all reasonable predictions.) "What are the chances of the cup landing on its side? On its bottom? On its top?" (Response should be one out of three.) "Even though a variety of results are possible, this is what should happen. What is another way of writing one out of three?" (Response should be 1/3). Read the following statement to the class: Probability often is shown as a fraction. (Prepare a class chart to show this. See Teacher Resource 1).

D. Do a class demonstration dropping the cup three times. Record the results of the demonstration after each of the actual drops by using a tally mark on the chart. Compare the predictions to the actual test results. Read the following to the class: "As you can see, what we expect to happen doesn't always happen. Can you think of other situations in our daily lives where we predict something is going to happen and it doesn't?" (For example, the weather forecaster says its going to be a beautiful day and it rains. Another example is when you are sure your team is going to win the baseball game and you lose instead.)

E. Divide the class into small cooperative groups (2-4 students). The teacher asks, "If you drop a cup fifteen times, predict the number of times it SHOULD land on its side, on its bottom, and on its top." (Discuss in fractional terms (5/15, 5/15, 5/15)). Record the class prediction. Each group will create tally sheets according to the model on the board. Students then will drop the cup from their waists fifteen times, recording the results on their charts. Post all of the group charts together in the front of the room. The teacher will then have each group share their results with the rest of the class. The class together will verbalize in fractional form the results from each chart. (Example: Barbara's group had the cup land on its side four out of fifteen times. The fraction will be 4/15.) Compare the actual results with what was predicted earlier.

Optional Extension Activity: Follow the same procedure as above, using a five-colored spinner instead of the cups, and use the following modifications:

- The chance will be one out of five with the spinner (1/5).
- Demonstrate this activity with the class five times.
- Do this activity in cooperative groups fifteen times.
- Groups should record results as a fraction independently. Then have the children determine the predicted color as greater than or less than the actual color results.

Day 3:

A. Review: What does the word "possible" mean? "Probable?" "Impossible?"

B. The teacher says, "Today we are going to continue exploring probability." Pass out graph paper and one square to each pair of students. Direct students to fold graph paper like a hotdog bun (Lengthwise). Draw a smiley face on one side of the paper square. Leave other side of the square plain. Predict what should happen when the square is flipped an even number of times (response: half smiley, half plain). In each pair, one student records tally marks on the graph paper while the other student flips the square until one of the columns reacher the tenth square on the grid. (Teacher demonstrates how to record tally marks; see Teacher Resource 2.)

C. Question: Is this what you expected to happen when you flipped the square? Discuss mathematical probability (what should happen) versus experimental probability (what does happen). At this time introduce the vocabulary "mathematical probability" and "experimental probability." Conclude that our prediction was based on mathematical probability. What we actually did was experimental probability.

D. Finally the teacher collects specific data from each pair of students (actual totals of smiley and plain results). The teacher and/or students add totals with a calculator to demonstrate and prove that "the more you experiment the closer you get to the mathematical probability." (Example: total tosses 200, students got 97 smiles and 103 plains).

Performance Assessment:

Hannah has to decide whether to go to the movies or the arcade on Saturday afternoon. Since she cannot do both, she must decide which activity to do. To solve her problem Hannah chooses to flip a coin. Which of the following statements is true about what will happen when Hannah flips the coin? Circle your answer.

a. The coin will land on heads.
b. The coin will land on tails.
c. The coin will have an equal chance of landing on heads or tails.

Write a paragraph using the vocabulary "fair," "unfair," "chance" and "probability" to explain how and why Hannah used a coin to solver her problem.

Rubric:

2 point answer - The paragraph gives a clear and complete description of why Hannah used the coin. Vocabulary words are used correctly.
1 point answer - The paragraph gives a limited explanation of why Hannah used the coin. It may include vocabulary words.
0 point answer - Other

Extension/Follow Up:

In All Probability: Investigations in Probability and Statistics.
Teacher's Guide Grades 3-6
LHS Gems
Great Explorations in Math and Science
Lawrence Hall of Science
University of California at Berkeley

Activity: Teddy Bears Playing in the Den

AIMS: Activities Integrating Math and Science
AIMS Education Foundation
P.O. Box 8120
Fresno, California 93747-8120

Resources:

Materials adapted from the following resources:

The Intermediate Mailbox, June/July 1993.
How Likely Is It ? Teacher's Guide, by Lappman, Fey, Fitzgerald, Friel, and Phillips

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1.

Up	Down	Side
1 out of 3	1 out of 3	1 out of 3
$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$

2.